



Potential malaria outbreak in Germany due to climate warming: Risk modelling based on temperature measurements and regional climate models

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Year: 2011
Journal: Environmental Science and Pollution Research International. 18 (3): 428-435

Abstract:

PURPOSE: Climate warming can change the geographic distribution and intensity of the transmission of vector-borne diseases such as malaria. The transmitted parasites usually benefit from increased temperatures as both their reproduction and development are accelerated. Lower Saxony (northwestern Germany) has been a malaria region until the 1950s, and the vector species are still present throughout Germany. This gave reason to investigate whether a new autochthonous transmission could take place if the malaria pathogen was introduced again in Germany. **MATERIALS and METHODS:** The spatial distribution of potential temperature-driven malaria transmissions was investigated using the basic reproduction rate ($R(0)$) to model and geostatistically map areas at risk of an outbreak of tertian malaria based on measured (1961-1990, 1991-2007) and predicted (1991-2020, 2021-2050, 2051-2080) monthly mean air temperature data. **RESULTS:** From the computations, maps were derived showing that during the period 1961-1990, the seasonal transmission gate ranges from 0 to 4 months and then expands up to 5 months in the period 1991-2007. For the projection of future trends, the regional climate models REMO and WettReg were used each with two different scenarios (A1B and B1). Both modelling approaches resulted in prolonged seasonal transmission gates in the future, enabling malaria transmissions up to 6 months in the climate reference period 2051-2080 (REMO, scenario A1B). **DISCUSSION:** The presented risk prognosis is based on the $R(0)$ formula for the estimation of the reproduction of the malaria pathogen *Plasmodium vivax*. The presented model focuses on mean air temperatures; thus, other driving factors like the distribution of water bodies (breeding habitats) or population density are not integrated. Nevertheless, the modelling presented in this study can help identify areas at risk and initiate prevention. The described findings may also help in the investigation and assessment of related diseases caused by temperature-dependent vectors and pathogens, including those being dangerous for livestock as well, e.g. insect-borne bluetongue disease transmitted by culicoids.

Source: <http://dx.doi.org/10.1007/s11356-010-0388-x>

Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES), Other Climate Scenario

Special Report on Emissions Scenarios (SRES) Scenario: SRES A1, SRES B1

Other Climate Scenario: REMO; WettReg

Early Warning System:

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure :

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Temperature

Temperature: Fluctuations

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Europe

European Region/Country: European Country

Other European Country : Germany

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type:

format or standard characteristic of resource

Climate Change and Human Health Literature Portal

Research Article

Timescale:

time period studied

Medium-Term (10-50 years)

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content